

What is claimed is:

1. An in-line production method to manufacture a partially diffusing optical fiber, having numerous longitudinally spaced illumination sites, comprising the continuous steps of:

- a) heating a preform starting material in an oven to form a zone of molten preform,
- b) drawing said molten preform zone to form an untreated optical fiber,
- c) treating said untreated optical fiber with at least one means for diffusion enhancement while said fiber is still continuous with said molten zone, to produce an enhanced optical fiber having diffusion sites, and
- d) repeating said treatment along a desired length of said fiber to form a desired pattern of said diffusion sites prior to severing said enhanced fiber from said untreated fiber.

2. The method according to claim 1, wherein said means to enhance the diffusion is selected from the group consisting of particle implantation, ion-implantation, high-energy laser, chemical, surface deposition, abrasion, and heating.

3. The method according to claim 1, wherein said means for diffusion enhancement are applied in selected combinations to treat said optical fiber.

4. The method according to claim 1, wherein said means for diffusion enhancement create patterns selected from a group consisting of random, radial, Bragg gratings, gradient index, step index and custom patterns.

5. The method according to claim 1, wherein all diffusion enhancement of said fiber is performed in a hot zone of said process prior to said fiber being coated with a polymer coating.

6. The method according to claim 1, wherein at least some diffusion enhancement is performed inside a hot zone of said process and at least some diffusion enhancement is performed outside said hot zone.

7. The method of according to claim 1, wherein said untreated optical fiber is drawn through a clean tube upon leaving said molten zone to protect said untreated

optical fiber from contamination.

8. An apparatus for manufacturing a partially diffusing fiber comprising means to melt a preform starting material, means to draw said preform into a fiber, means to protect said fiber from contamination, means to control fiber draw speed, means to control fiber enhancement patterns, means to maintain a hot zone and at least one means to enhance diffusion.

9. The apparatus according to claim 8, wherein said means to protect said fiber from contamination is a clean tube.

10. The apparatus according to claim 8, wherein said means to enhance diffusion is selected from a group consisting of particle implanters, ion-implanters, high-energy lasers, chemical vaporizers, chemical sprayers, surface deposition devices, abrasion devices, and heaters.

11. The apparatus according to claim 10, wherein said means to enhance diffusion are positioned along a length of said fiber and axially about said fiber.

12. The apparatus according to claim 8, wherein the means to control fiber draw speed and means to control diffusion enhancement means is a computer.

13. A partially diffusing optical fiber produced by the method according to claim 1, where said fiber is produced in commercial lengths.

14. The partially diffusing optical fiber according to claim 13, wherein said fiber is cut to custom lengths at time of use.

15 A distributed sensor comprising a light detector coupled to a partially diffusing fiber, wherein light energy entering said diffusing fiber is monitored to provide information about an environment where said diffusing fiber is placed.